

**What is claimed is:**

1. An article machining apparatus adapted for use with a machine vise having a pair of vice jaws with hardened article engagement surface article engagement surfaces, the apparatus comprising:

an article holding fixture having an upper article securing section connected to a bridge at an upper end and a foot section connected to the bridge at a lower end, the foot section having an attached group of gauge pins arranged in a pattern wherein a first gauge pin contacts a first spacer block of a predetermined collection of spacer blocks, a second gauge pin contacts a first expandable vice jaw and a third gauge pin contacts a vertical surface of a second vice jaw, accordingly; and,

a third spacer block of the predetermined collection of gauge blocks that contacts the second vice jaw while supporting the third gauge pin, and a fourth gauge pin interfaced between the first spacer block and a second spacer block contacting the third spacer block so that a horizontal surface of the first spacer block determines a vertical position of the first and second gauge pins while the pair of vise jaws clamp the article holding fixture between the second and third gauge pins, thereby satisfying requirements of orienting the article holding fixture at a desired angle for machining an article secured to the upper article securing section of the article holding fixture.

Claim 2. - An article machining apparatus as recited in Claim 1 wherein the desired angle is in a range of 0 to 45 degrees.

Claim 3. An article machining apparatus as recited in Claim 1 wherein the attached group of gauge pins includes the first and second gauge pins of equal diameter and the third gauge pin having a different diameter.

Claim 4. An article machining apparatus as recited in Claim 1 wherein the attached group of gauge pins includes the first and second gauge pins being .375 inches in diameter and the third gauge pin has a .500-inch diameter.

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Claim 5. An article machining apparatus as recited in Claim 1 wherein the article holding fixture comprising the upper section, bridge and lower section are formed as a casting with a group of machined surfaces to locate and secure the first, second and third gauge pins to a respective machine surface and to further secure and locate an article to be machined on an article receiving surface located on the upper article securing section.

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Claim 6. An article machining apparatus adapted for use with a machine vise having a pair of vice jaws with hardened article engagement surface article engagement surfaces, the apparatus comprising:  
an article holding fixture having a first, second and third gauge pin attached thereto and a set of at least two spacer blocks; and  
a mathematical program derived from a MSN Excel™ program suited for manual entry of a collection of data into a set of formulas in order to calculate a set of dimensions and components for a predetermined set-up angle for machining an article secured to an article holding fixture.

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Claim 7. An article machining apparatus as recited in Claim 6 wherein at least the first gauge pin has a diameter that is determined from entering the collection of data into the mathematical program and the at least two spacer blocks have dimensions derived from entering the collection of data as a result of processing the data in order to satisfy a condition designed to meet the predetermined angular position of the article holding fixture.

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Claim 8. An article machining apparatus according to Claim 6 wherein the set of formulas includes:

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a.  $x_1=r_1$ ;  $x_2= (H-r_1-r_2) \sin \theta$ ;  $x_3=y_2 \sin \theta$ ;  $x_4= (W-d_3-y_2) \cos \theta$ ;  
 $x_5=r_3 (1-\tan \theta) \cos \theta$ ;  $x_6=r_3$ ;

b.  $y_1=r_2 (1-\cos \theta)$ ;  $y_2= (W-d_3-r_2) \sin \theta$ ;  $y_3=r_3/\cos \theta$ ;  $y_4=r_3 (1-\tan \theta) \sin \theta$ ;  $y_5=r_3$ .

5 Claim 9. An article machining apparatus as recited in Claim 8 wherein the dimensions  $x_1$ ,  $x_2$ ,  $x_3$ ,  $x_4$ ,  $x_5$ ,  $x_6$ ,  $y_1$ ,  $y_2$ ,  $y_3$ ,  $y_4$ , and  $y_5$  resulting from data entry for the formulas (a.) and (b) are derived from entering each corresponding component of each formula of the set of formulas in the MSN Excel program.

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Claim 10. An article machining apparatus adapted for use with a machine vise having a pair of vice jaws with hardened article engagement surface article engagement surfaces, the apparatus comprising:  
an article holding fixture having an upper article securing section connected  
15 to a bridge at an upper end and a foot section connected to the bridge at a lower end, the foot section having an attached group of gauge pins arranged in a pattern wherein a first gauge pin contacts a first spacer block located between the vice jaws on the floor surface of the machine vise, while a second gauge pin contacts a first expandable vice jaw, and a third  
20 gauge pin contacts a vertical surface of a second vice jaw and a top surface of a third spacer block while a fourth gauge pin contacts a vertical surface of the first spacer block and a vertical surface of a second spacer block of a collection of spacer blocks when the first and second vice jaws are clamped together according to a predetermined angular position of the article holding  
25 fixture thereby positioning the article holding fixture at a predetermined angle; and  
a reference table for selecting a predetermined angular position of the article holding fixture as a result of entering a set of fixed values representing the diameter of the first, second and third gauge pins into a  
30 mathematical program for calculating a dimension of the spacer block for positioning the article holding fixture within the machine vice jaws.

Claim 11. A process for setting up an article holding fixture for machining an article secured to the fixture while the fixture is clamped within a machine vise, the process comprising:

- a. determining a number of fixed dimensional values of a set of gauge pins and a desired set-up angle from a table representing a set-up angle and a cross reference to the fixed dimensional values;
- b. entering the fixed dimensional values and desired angle into a MSN Excel <sup>TM</sup> program to provide a set of fixed dimensional values of a gauge pin and a complementary set of spacer blocks according to a set of predetermined formulas representing a number of specific components of the set-up angle for positioning the article holding fixture;
- c. installing the number of specific components inside of the machine vise within a clamping area of the vise according to a computed set of dimensions determined by the MSN Excel program; and
- d. clamping a pair of expandable vise jaws associated with the vise so as to locate and secure the number of specific components for locating the article holding fixture.

Claim 12- An article machining apparatus adapted for use with a machine vise having a pair of vice jaws with hardened article engagement surface article engagement surfaces, the apparatus comprising:  
an article holding fixture having an upper article securing section connected to a bridge at an upper end and a foot section connected to the bridge at a lower end, the foot section having an attached group of gauge pins arranged in a pattern wherein a first gauge pin contacts a first spacer block located between the vice jaws on the floor surface of the machine vise, while a second gauge pin contacts a first expandable vice jaw, and a third gauge pin contacts a horizontal surface of at a third spacer block of a stack of spacer blocks and a vertical surface of a second vice jaw while a fourth gauge pin contacts a vertical surface of the first spacer block and a vertical

surface of a second spacer block when the first and second vice jaws are clamped together, according to a predetermined angular position of the article holding fixture thereby positioning the article holding fixture at a predetermined angle; and

5 a reference table for selecting a predetermined angular position of the article holding fixture as a result of entering a set of fixed values representing the diameter of the first, second and third gauge pins into a mathematical program for calculating a dimension of the spacer block for positioning the article holding fixture within the machine vice jaws.

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Claim 13- An article machining apparatus as recited in Claim 12 wherein the pretermned angle is in a range of 0 to 45 degrees.

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Claim 14- An article machining apparatus adapted for use with a machine vise having a pair of vice jaws with hardened article engagement surface article engagement surfaces, the apparatus comprising:  
an article holding fixture having an upper article securing section oriented at substantially 45 degrees with respect to ground, the securing section connected to a bridge at an upper end and a foot section connected to the  
20 bridge at a lower end, the foot section having an attached group of gauge pins arranged in a pattern wherein a first gauge pin contacts a first spacer block located between the vice jaws on the floor surface of the machine vise, while a second gauge pin contacts a first expandable vice jaw, and a third gauge pin contacts a horizontal surface of at a third spacer block of a  
25 group of spacer blocks, and a vertical surface of a second vice jaw while a fourth gauge pin contacts a vertical surface of the first spacer block and a vertical surface of a second spacer block when the first and second vice jaws are clamped together, according to a predetermined angular position of the article holding fixture thereby positioning the article holding fixture at  
30 a predetermined angle; and

a reference table for selecting a predetermined angular position of the article holding fixture as a result of entering a set of fixed values representing the diameter of the first, second and third gauge pins into a mathematical program for calculating a dimension of the spacer block for positioning the article holding fixture within the machine vice jaws.

Claim 15- An article machining apparatus as recited in Claim 14 wherein the pretermined angle is in a range of 45 to 90 degrees.